Claims

[c1] 1.A method for detection of solid materials present within a medium of interest, the method comprising:
configuring the medium of interest within an electromagnetic circuit;
exciting the medium of interest using electromagnetic energy; and
determining an impedance value of said electromagnetic circuit, wherein said impedance value corresponds to an amount of solid material within the medium of interest.

[c2] 2.The method of claim 1, wherein said electromagnetic circuit further comprises at least one of a microwave circuit and a radio frequency (RF) circuit.

[c3] 3.The method of claim 1, wherein the medium of interest is excited into a plasma state by at least one of a microwave energy source and an RF source.

[c4] 4.The method of claim 1, wherein said determining an impedance value further comprises determining a reflection coefficient magnitude value and a reflection coefficient phase value.

[c5] 5.The method of claim 4, further comprising determining variations of said reflection coefficient magnitude and phase values over time.

[c6] 6.A method for solid material detection in a photoresist removal system, the method comprising:
receiving an exhaust gas downstream with respect to a workpiece from which a photoresist material is removed;
configuring an electromagnetic circuit to include said exhaust gas;
exciting said exhaust gas using electromagnetic energy; and
determining an impedance value of said microwave circuit, wherein said impedance value corresponds to an amount of solid material within the exhaust gas.

[c7] 7.The method of claim 6, wherein said electromagnetic circuit further comprises at least one of a microwave circuit and a radio frequency (RF) circuit.

[c8] 8.The method of claim 6, wherein said exhaust gas is excited into a plasma state by at least one of a microwave energy source and an RF source.

[c9] 9.The method of claim 6, wherein said determining an impedance value further comprises determining an impedance magnitude value and an impedance phase

value.

[c10] 10.The method of claim 9, further comprising determining variations of said impedance magnitude and phase values over time.

[c11] 11.The method of claim 9, wherein said electromagnetic energy is applied at a power of about 200 watts (W) to about 400 W.

[c12] 12.The method of claim 9, wherein said electromagnetic energy is applied at a power of about 300 watts (W).

[c13] 13.The method of claim 9, further comprising utilizing said determined impedance values for endpoint detection of removal of said photoresist material.

[c14] 14.A material detection system, comprising:
a flow path configured to contain a medium of interest in which solid material is to be detected;
an electromagnetic energy source for exciting said medium of interest; and
an impedance measuring device for measuring an impedance value of an electromagnetic circuit, said electromagnetic circuit including said flow path therein, wherein said impedance value corresponds to an amount of solid material within said medium of interest.

[c15] 15.The material detection system of claim 14, wherein said electromagnetic circuit further comprises at least one of a microwave circuit and a radio frequency (RF) circuit.

[c16] 16.The material detection system of claim 14, wherein said electromagnetic energy source is configured to excite said medium of interest into a plasma.

[c17] 17.The material detection system of claim 14, wherein said impedance measuring device is configured to determine an impedance magnitude value and an impedance phase value.

[c18] 18.The material detection system of claim 17, further comprising a mechanism for determining variations of said impedance magnitude and phase values over time.

[c19] 19.A plasma based semiconductor material removal system, comprising:
an upstream electromagnetic energy source configured to cause excitation of an input gas into a plasma so as to produce a reactive species;
a mechanism for uniformly conveying said reactive species to a surface of a workpiece having photoresist material formed thereupon;
a mechanism for heating said workpiece so as to en-

hance the reaction rate of said photoresist material and said reactive species;

a downstream electromagnetic energy source for exciting an exhaust gas downstream of said workpiece; and

an impedance measuring device for measuring an impedance value of an electromagnetic circuit, said electromagnetic circuit including said exhaust gas therein, wherein said impedance value corresponds to an amount of solid material within said exhaust gas.

[c20] 20.The system of claim 19, wherein said electromagnetic circuit further comprises at least one of a microwave circuit and a radio frequency (RF) circuit.

[c21] 21.The system of 19, wherein said downstream electromagnetic energy source is configured to excite said medium of interest into a microwave plasma.

[c22] 22.The system of claim 19, wherein said impedance measuring device is configured to determine an impedance magnitude value and an impedance phase value.

[c23] 23.The system of claim 22, further comprising a mechanism for determining variations of said impedance magnitude and phase values over time.

[c24] 24.The method of claim 22, wherein said downstream

electromagnetic energy source is configured to apply power at a power level of about 200 watts (W) to about 400 W.

[c25] 25.The method of claim 22, wherein said downstream electromagnetic energy source is configured to apply power at a power level of about 300 watts (W).

[c26] 26.The system of claim 19, wherein said impedance measuring device is configured for facilitating endpoint detection of removal of said photoresist material.

[c27] 27.A method for implementing material removal from a semiconductor workpiece, the method comprising:
receiving an exhaust gas containing material removed from the workpiece;
applying a first power level to an electromagnetic circuit, said electromagnetic circuit containing said exhaust gas therein, wherein said first power level is sufficient to volatize solid material contained within said exhaust gas;
applying a second power level to said electromagnetic circuit for a selected duration; and
during said selected duration, using said electromagnetic circuit to detect the presence of remaining solid material within said exhaust gas.

[c28] 28.The method of claim 27, wherein said electromag-

netic circuit further comprises at least one of a microwave circuit and a radio frequency (RF) circuit.

[c29] 29.The method of claim 27, further comprising measuring an impedance of said electromagnetic circuit to detect the presence of remaining solid material within said exhaust gas.

[c30] 30.The method of claim 27, wherein said first power level is reapplied following said selected duration whenever remaining solid material is detected.

[c31] 31.The method of claim 29, further comprising repeating said applying said first and second power levels until remaining solid material is no longer detected.